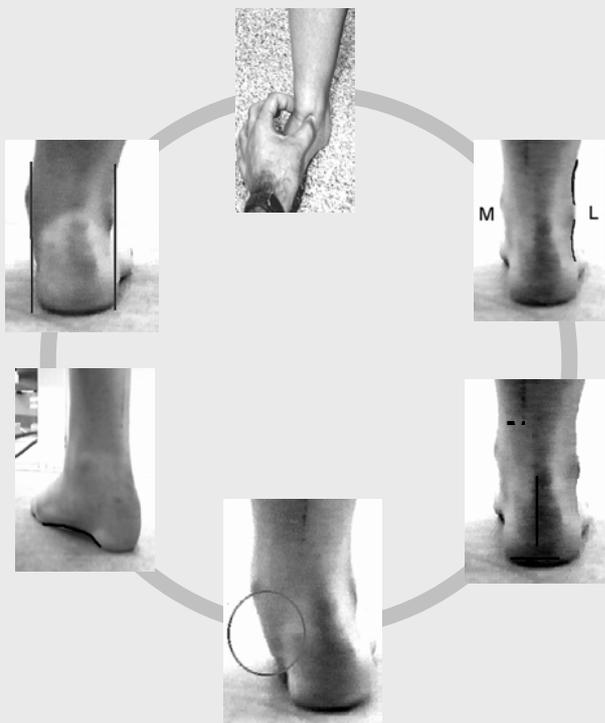


# **THE FOOT POSTURE INDEX<sup>®</sup>**

***Easy quantification of  
standing foot posture***

***Six item version  
FPI-6***

***USER GUIDE AND MANUAL***



***AUGUST 2005***

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## **About the author**

Dr Anthony Redmond is Arthritis Research Campaign lecturer in the Academic Unit of Musculoskeletal Disease at the University of Leeds. He has worked in clinical podiatry and foot-related research for the majority of his career, mostly in multidisciplinary gait and lower limb clinics. The FPI was conceived as a part answer to the recurring clinical problem of assessing gait and foot posture variables reliably in the clinical setting. Work first started on the various iterations of the FPI in 1996, with a more formal approach to the development of the FPI as part of his PhD candidature in the faculty of medicine at the University of Sydney. Various iterations have appeared in the literature<sup>†</sup> but only this six-item version has completed all validation studies satisfactorily. We now recommend that the use of any previous versions be discontinued.

The validation process is described in full in:

*Redmond AC. Foot Posture in Neuromuscular Disease (PhD Thesis) University of Sydney, 2004.*

*Redmond AC., Crosbie J., Ouvrier RA. Development and validation of a novel rating system for scoring foot posture: the Foot Posture Index. Clinical Biomechanics (In Press)*

## **FPI manuals and datasheets**

The FPI concept and data sheets have been released into the public domain. The datasheets may be copied freely for clinical or research purposes although they should not be altered or adapted without the express permission of the copyright holder. All rights are reserved for this manual/user guide and it should not should be copied or redistributed in any form without the author's express consent.

Further information can be found on-line at [www.leeds.ac.uk/medicine/FASTER/FPI](http://www.leeds.ac.uk/medicine/FASTER/FPI)

A.R. August 2005

<sup>†</sup> Redmond A, Burns J, Crosbie J, Ouvrier R, Peat J. An initial appraisal of the validity of a criterion based, observational clinical rating system for foot posture. *Journal of Orthopedic and Sports Physical Therapy* 2001;31(3):160.

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Yates B, White S. The incidence and risk factors in the development of medial tibial stress syndrome among naval recruits. *Am J Sports Med* 2004; 32(3): 772-780

## **Introduction**

The Foot Posture Index (FPI) is a diagnostic clinical tool aimed at quantifying the degree to which a foot can be considered to be in a pronated, supinated or neutral position.

It is intended to be a simple method of scoring the various features of foot posture into a single quantifiable result, which in turn gives an indication of the overall foot posture. The foot posture index rates weightbearing posture according to a series of predefined criteria. The FPI started life as an eight-item draft version, which during a thorough validation process was eventually refined to the six-item version detailed in this manual.

All observations are made with the subject standing in a relaxed angle and base of gait, double limb support, static stance position. This relaxed double limb support position has been reported to approximate the position about which the foot functions during the gait cycle.

## **Derivation of the foot posture index**

The FPI was derived from a search of the literature yielding details of clinical assessment in more than 140 papers. From these 140 papers, 36 distinct clinical measures were identified. In identifying indicators potentially appropriate for use in the FPI, emphasis was placed on indicators that met the following criteria:

- a) Measures must be easy to conduct
- b) Measures must be time-efficient to perform
- c) Using the measures must not depend on costly technology
- d) The results of the measure must be simple to understand
- e) Assessment yields quantifiable data (at a minimum of ordinal level)

In addition it was considered essential for the combination of the chosen measures to, between them, measure foot posture in all of the three body planes and to also provide information on rearfoot, midfoot and forefoot segments.

Eight measures were incorporated into a working draft of the FPI and this was refined to six items after a series of validation studies.

## **Scoring foot posture**

The user attaches a score to a series of observations that are routinely used by experienced practitioners. Features commensurate with an approximately neutral foot posture are graded as zero, while pronated postures are given a positive value, and supinated features a negative value.

When the scores are combined, the aggregate value gives an estimate of the overall foot posture. High positive aggregate values indicate a pronated posture, significantly negative aggregate values indicate a supinated overall foot posture, while for a neutral foot the final FPI aggregate score should lie somewhere around zero. While the measures are conducted in double limb support each foot should be scored independently.

**FPI scoring criteria**

The six clinical criteria employed in the FPI-6 are:

1. Talar head palpation
2. Supra and infra lateral malleolar curvature
3. Calcaneal frontal plane position
4. Prominence in the region of the talonavicular joint
5. Congruence of the medial longitudinal arch
6. Abduction/adduction of the forefoot on the rearfoot

**Using the specified criteria**

Full explanations of each of the FPI constituent parts are detailed subsequently, and the derivation of each is referenced and detailed in Appendix 1. Each of the component tests or observations are simply graded 0 for neutral, with a minimum score of -2 for clear signs of supination, and + 2 for positive signs of pronation. Unless the criteria outlined for each of the features are clearly met then the more conservative score should be awarded. It is also to be emphasised that the gradings need to be awarded on the basis of the criteria outlined below. Variation resulting from observations based on 'clinical feel' or past experience alone will result in unacceptable inter-observer error.

**Preparing the patient**

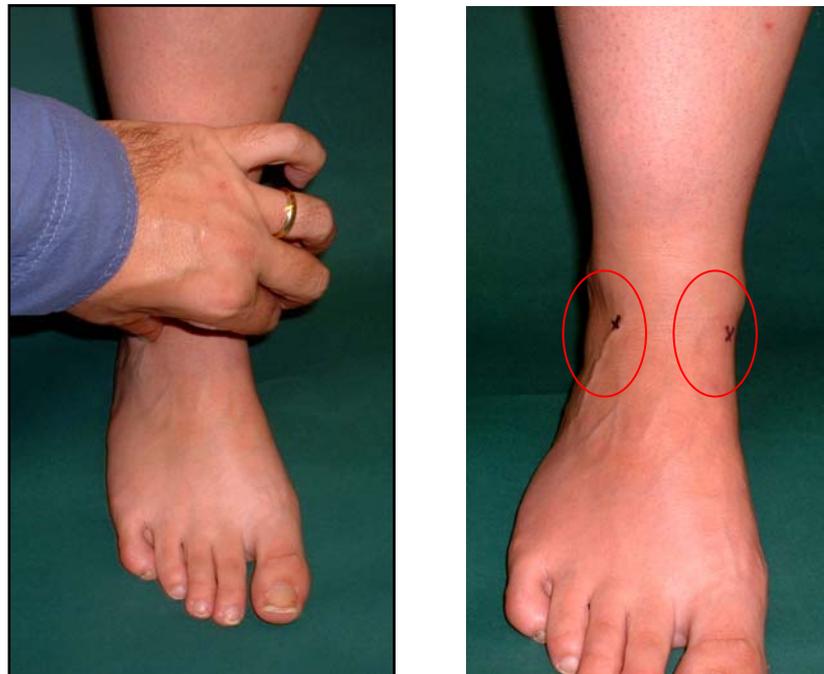
The patient should stand in their relaxed stance position with double limb support. The patient should be instructed to stand still, with their arms by the side and looking straight ahead. It may be helpful to ask the patient to take several steps, marching on the spot, prior to settling into a comfortable stance position. During the assessment, it is important to ensure that the patient does not swivel to try to see what is happening for themselves, as this will significantly affect the foot posture. The patient will need to stand still for approximately two minutes in total, in order for the assessment to be conducted. The assessor needs to be able to move around the patient during the assessment and to have uninterrupted access to the posterior aspect of the leg and foot.

## 1. Talar Head Palpation

**(Palpation for talo-navicular congruence)**

This is the only scoring criterion that relies on palpation rather than observation. The head of the talus is palpated on the medial and lateral side of the anterior aspect of the ankle, according to the standard method described variously by Root, Elveru and many others. Scores are awarded for the observation of the position as follows.

**Diagram showing the position of the fingers when palpating of the head of the talus. The circles indicate the precise point of palpation on the medial and lateral side.**



**Clinical note:** This is not an attempt to determine the so-called subtalar neutral position. For the FPI measure the subtalar joint is **not** manipulated into the position where the head of the talus is in maximal congruence with the navicular. For the FPI measure the head of the talus is simply palpated in the **relaxed stance position** and the talar head orientation reported.

It may however be useful in some cases to move the foot into inversion and eversion while palpating for the talar head as this can aid in determining whether the head is still palpable in individuals on the border between 1 & 2 or -1 & -2.

Score	-2	-1	0	1	2
	Talar head palpable on lateral side/ but not on medial side	Talar head palpable on lateral side/ slightly palpable on medial side	Talar head equally palpable on lateral and medial side	Talar head slightly palpable on lateral side/ palpable on medial side	Talar head not palpable on lateral side/ but palpable on medial side

**2. Supra and infra lateral malleolar curvature**

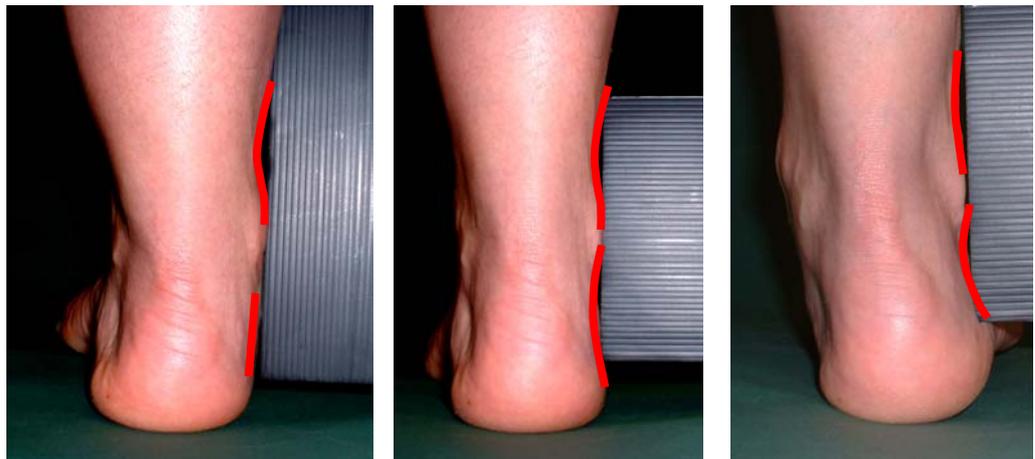
**(Observation and comparison of the curves above and below the lateral ankle malleoli)**

In the neutral foot it has been suggested that the curves should be approximately equal. In the pronated foot the curve BELOW the malleolus will be more acute than the curve above due to the abduction of the foot, and eversion of the calcaneus. The opposite is true in the supinated foot.

**Supinated (-2)**

**Neutral (0)**

**Pronated (+2)**



**Clinical note 1:** For estimating malleolar curvature, it may be helpful to use a straight edge for reference. This can be a set square, ruler or even a pen according to availability.

Score	-2	-1	0	1	2
	Curve below the malleolus either straight or <u>convex</u>	Curve below the malleolus concave, but flatter/ more shallow than the curve above the malleolus	Both infra and supra malleolar curves roughly equal	Curve below malleolus more <u>concave</u> than curve above malleolus	Curve below malleolus <i>markedly</i> more concave than curve above malleolus

**Clinical note 2:** Where oedema or obesity obscures the curvature this measure should be either scored at zero or removed from the assessment and indicated as such.

### 3. Calcaneal frontal plane position

(Inversion / eversion of the calcaneus)

This is an observational equivalent of the measurements often employed in quantifying the relaxed and neutral calcaneal stance positions. With the patient standing in the relaxed stance position, the posterior aspect of the calcaneus is visualised with the observer in line with the long axis of the foot.

Angular measurements are not required for the FPI, the foot is graded according to visual appraisal of the frontal plane position.

**Supinated (-2)**



**Neutral (0)**



**Pronated (+2)**



Score	-2	-1	0	1	2
	More than an estimated 5° inverted (varus)	Between vertical and an estimated 5° inverted (varus)	Vertical	Between vertical and an estimated 5° everted (valgus)	More than an estimated 5° everted (valgus)

**4. Bulging in the region of the talo-navicular joint (TNJ)**

In the neutral foot the area of skin immediately superficial to the TNJ will be flat. The TNJ becomes more prominent if the head of the talus is adducted in rearfoot pronation. Bulging in this area is thus associated with a pronating foot. In the supinated foot this area may be indented.

**Supinated (-2)**

**Neutral (0)**

**Pronated (+2)**



Score	-2	-1	0	1	2
	Area of TNJ markedly concave	Area of TNJ slightly, but definitely concave	Area of TNJ flat	Area of TNJ bulging slightly	Area of TNJ bulging markedly

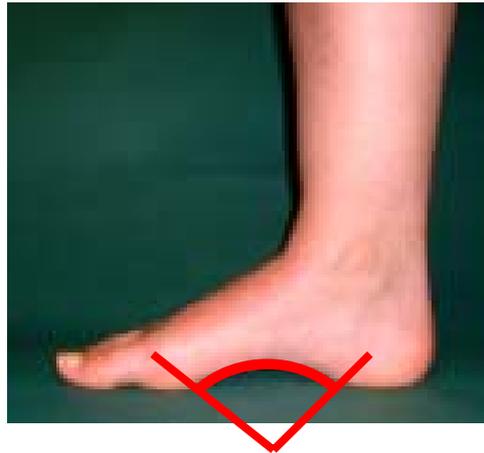
**Clinical note:**

*Bulging of the TNJ area is a common finding in pronated feet. However, true convexity of the area is usually only seen with highly supinated postures. Unless there is a definite indentation, assigning negative scores to this observation should be undertaken judiciously.*

**5. Height and congruence of the medial longitudinal arch**

While arch height is a strong indicator of foot function, the shape of the arch can also be equally important. In a neutral foot the curvature of the arch should be relatively uniform, similar to a segment of the circumference of a circle. When a foot is supinated the curve of the MLA becomes more acute at the posterior end of the arch. In the excessively pronated foot the MLA becomes flattened in the centre as the midtarsal and Lisfranc’s joints open up.

**Neutral (0)**



This observation should be made taking both the arch height and the arch congruence into consideration.

**Supinated foot (-2)**



**Pronated foot (+2)**



***Clinical note:** While simple arch height will usually be the more readily apparent of the two components of this measure, arch congruence is probably more subtle and informative. Careful observation of the arch congruence should be the main element of this measure with arch height factored in secondarily.*

Score	-2	-1	0	1	2
	Arch high and acutely angled towards the posterior end of the medial arch	Arch moderately high and slightly acute posteriorly	Arch height normal and concentric ally curved	Arch lowered with some flattening in the central portion	Arch very low with severe flattening in the central portion – arch making ground contact

**6. Abduction/ adduction of the forefoot on the rearfoot.**

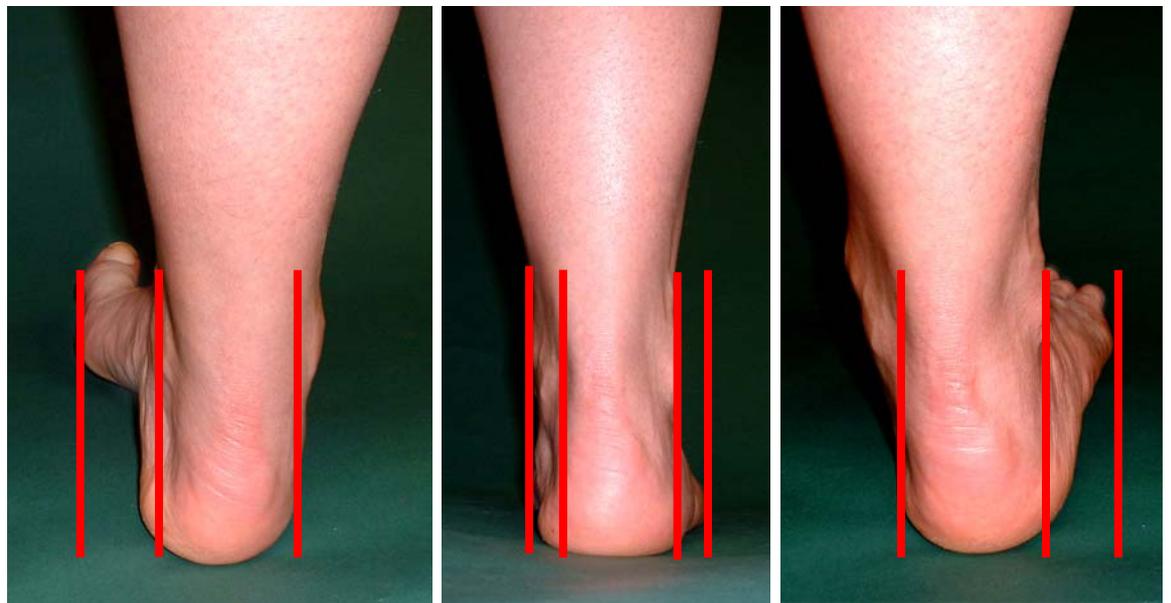
**(Too many toes sign)**

When viewed from directly behind, and in-line with the long axis of the **heel** (not the long axis of the whole foot), the neutral foot will allow the observer to see the forefoot equally on the medial and lateral sides. In the supinated foot the forefoot will adduct on the rearfoot resulting more of the forefoot being visible on the medial side. Conversely pronation of the foot causes the forefoot to abduct resulting in more of the forefoot being visible on the lateral side.

**Supinated (-2)**

**Neutral(0)**

**Pronated (+2)**



**Clinical note:** This measure should be treated with caution where there is a fixed adduction deformity of the forefoot on the rearfoot in the non-weightbearing state. Normally it is possible to see the toes by the observer raising their angle of view slightly. If the toes are obscured by other structures the mtp joints or more proximal structures can be used as a guide.

Score	-2	-1	0	1	2
	No lateral toes visible. Medial toes clearly visible	Medial toes clearly more visible than lateral	Medial and lateral toes equally visible	Lateral toes clearly more visible than medial	No medial toes visible. Lateral toes clearly visible

**FPI total score**

The final FPI score will be a whole number between -12 and +12.

In most cases there will be a consistent pattern of scores and the clinical picture will be immediately clear. However in some patients there will be a dominance of motion occurring in one of the three body planes or a difference between the function of the forefoot and rearfoot.

The foot segments and the body plane measured by each of the observations are indicated on the FPI data sheet. This allows the FPI to provide substantially more information than existing single segment/single plane assessment techniques. While the information needs careful clinical interpretation based on the clinician's knowledge of anatomy and function, the information yielded by the FPI assessment allows such interpretation to be better informed by data.

*Examples*

*Example 1. Abnormal frontal plane observations predominate in a patient, with transverse and sagittal plane measures reading near neutral.*



<i>Talar head palpation</i>	+1
<i>Malleolar curves</i>	+1
<i>Inv/eversion calcaneus</i>	+1
<i>TNJ prominence</i>	0
<i>Congruence of MLA</i>	0
<i>Abd/adduction of FF</i>	+1
<hr/>	
<i>TOTAL</i>	+4

*Example 2. The rearfoot factors may be near less marked in a patient while the midfoot/forefoot observations indicate substantial instability in the midfoot.*



<i>Talar head palpation</i>	<i>+1</i>
<i>Malleolar curves</i>	<i>+1</i>
<i>Inv/eversion calcaneus</i>	<i>+1</i>
<i>TNJ prominence</i>	<i>+2</i>
<i>Congruence of MLA</i>	<i>+2</i>
<i>Abd/adduction of FF</i>	<i>+1</i>
<hr/>	
<i>TOTAL</i>	<i>+8</i>

In both of these cases the clinician interprets the results to put the foot posture into its clinically relevant context. The clinician may decide to use the FPI as a general overview of the foot function (just using the total score) or conversely he or she may prefer to keep the planar or segmental information disaggregated in order to retain the differentiation of the individual components of the score. Either way the clinician has more information available, upon which to base a decision.

### **Getting to know the FPI**

The FPI is designed to be simple to use and for the set criteria to limit variability in scoring. Nevertheless, it is worth developing some exercise with using the measure before applying the scores in earnest.

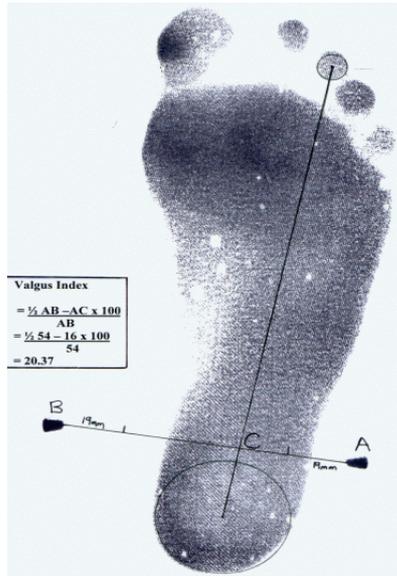
We recommend that the novice user rates approximately 30 individuals with as broad a range of foot types as possible before using the FPI formally in clinic.

**Validation of the FPI**

The validation of the FPI was conducted in several stages.

*Item validity*

FPI scores were compared initially to concurrently derived Valgus Index (VI) scores. Ratings of the eight components making up the draft FPI were undertaken for each of 131 subjects (91 male and 40 female aged 18-65 (Mean=33.7 years) while they stood on a 'pedograph', ink and paper mat.



In ordinal regression modelling the FPI-8 total scores predicted 59% of the variance in VI values (Cox and Snell  $R^2=0.590$ ,  $B=0.551$ ,  $P<0.001$ ,  $N=131$ )

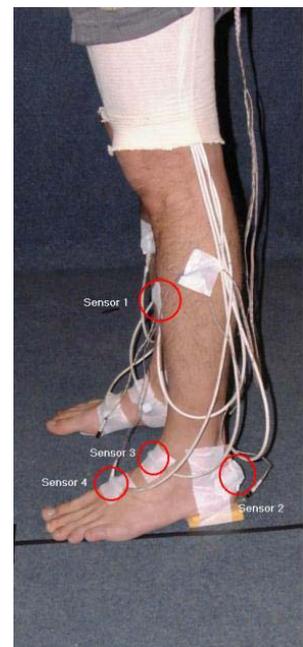
The inter-item reliability (Cronbach's  $\alpha$ ) was 0.834, indicating good inter-item reliability overall. The individual coefficients were  $>0.65$  for six of the eight FPI components. The components measuring Helbing's sign (0.36) and the congruence of the lateral border (0.20) of the foot showed poor inter-item reliability.

Principal components analysis yielded two separate factors. The first included seven of the initial eight FPI items. A second factor, explaining 12% of the variance, was mainly a function of the congruence of the lateral border of the foot suggesting that a separate subgroup with variation in foot position independent of the lateral foot contour might be evident.

A Fastrak™ electromagnetic tracking (EMT) system was then used to reconstruct a three-dimensional lower limb model for the right leg of 20 healthy volunteers in each of three positions (pronated, neutral, supinated). The FPI scoring criteria (again except lateral border shape) predicted between 63% and 80% of the variance in their EMT derived equivalents.

*Item reduction*

The items Lateral border congruence and Helbing's sign had not demonstrated adequate validity and were removed to produce the final six-item instrument.



## Validation of the FPI

### *FPI-6 Instrument validity*

Once the FPI had been reduced to its final six-item form the validity was evaluated further. Six item FPI scores were compared with contemporaneous EMT data obtained during quiet standing and during normal walking. The FPI-6 scores predicted 64% of the variation in the static ankle/subtalar position during quiet double limb standing (adjusted  $R^2=0.64$ ,  $F=73.529$ ,  $P<0.001$ ,  $N=14$ ). The same FPI-6 scores predicted 41% of the variance in ankle/subtalar position at midstance ( $R^2 = 0.41$ ,  $F=31.786$ ,  $P<0.001$ ,  $N=15$ ).

### *Reliability*

Reliability is a function of the user and patient group being investigated rather than a characteristic of the instrument. The independently reported inter-tester reliability of the original eight item FPI has ranged from 0.62 to 0.91, depending on population, and intra-tester reliability ranges from 0.81 to 0.91

### *See*

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*Burns J., Keenan A., Redmond AC. Foot type and lower limb overuse injury in triathletes. J Am Pod Med Assoc 2005, 95:3; 235-241.*

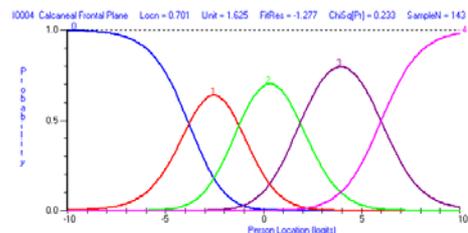
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*Yates B, White S. The incidence and risk factors in the development of medial tibial stress syndrome among naval recruits. Am J Sports Med 2004: 32 (3): 772-780*

## Psychometric properties

The psychometric properties including uni-dimensionality and item-functioning have been evaluated and demonstrated good fit to the Rasch model. The robustness of its psychometric properties (High person separation, no differential item functioning and good item fit), combined with the number of levels in the scoring scale (25) means that the FPI can be used in studies employing parametric statistical analysis.



### *See*

*Keenan AM, Redmond AC, Horton M, Conaghan PC, Tennant A. "The Foot Posture Index: Rasch analysis of a novel, foot specific outcome measure". Health Outcomes 2005: making a difference. Book of Proceedings. 11th Annual National Conference, 17-18 August 2005, Canberra, Australia.*

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(Sanner compared medial and lateral malleoli)

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**Calcaneal  
frontal plane  
position**

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***Prominence in the region of the talonavicular joint***

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***Abduction/  
adduction of  
the forefoot on  
the rearfoot.***

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## Foot Posture Index Datasheet

<b>Patient name</b>	<b>ID number</b>
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	FACTOR	PLANE	SCORE 1		SCORE 2		SCORE 3	
			Date_____		Date_____		Date_____	
			Comment_____		Comment_____		Comment_____	
			Left -2 to +2	Right -2 to +2	Left -2 to +2	Right -2 to +2	Left -2 to +2	Right -2 to +2
<b>Rearfoot</b>	Talar head palpation	<i>Transverse</i>						
	Curves above and below the lateral malleolus	<i>Frontal/ transverse</i>						
	Inversion/eversion of the calcaneus	<i>Frontal</i>						
<b>Forefoot</b>	Prominence in the region of the TNJ	<i>Transverse</i>						
	Congruence of the medial longitudinal arch	<i>Sagittal</i>						
	Abd/adduction forefoot on rearfoot	<i>Transverse</i>						
	<b>TOTAL</b>							

**Reference values**

Normal = 0 to +5

Pronated = +6 to +9, Highly pronated 10+

Supinated = -1 to -4, Highly supinated -5 to -12

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## Foot Posture Index Datasheet

<b>Patient name</b>	<b>ID number</b>
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	FACTOR	PLANE	SCORE 1		SCORE 2		SCORE 3	
			Date_____		Date_____		Date_____	
			Comment_____		Comment_____		Comment_____	
			Left -2 to +2	Right -2 to +2	Left -2 to +2	Right -2 to +2	Left -2 to +2	Right -2 to +2
<b>Rearfoot</b>	Talar head palpation	<i>Transverse</i>						
	Curves above and below the lateral malleolus	<i>Frontal/ transverse</i>						
	Inversion/eversion of the calcaneus	<i>Frontal</i>						
<b>Forefoot</b>	Prominence in the region of the TNJ	<i>Transverse</i>						
	Congruence of the medial longitudinal arch	<i>Sagittal</i>						
	Abd/adduction forefoot on rearfoot	<i>Transverse</i>						
	<b>TOTAL</b>							

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